Does Foot Type Affect Foot Contact Dynamics?

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INTRODUCTION

Human movement is influenced by foot structure. Pes cavus is associated with clawing of the great and lesser toes [1], and sometimes with pain. [2] Pes planus is associated with increased plantar surface contact area and can be a risk factor in the development of overuse injuries [3]. Foot type was found to affect the center of pressure excursion index (CPEI). [4] Although important when planning treatment for pes cavus and pes planus feet, the effects of foot type on foot contact dynamics and function are not well understood. Hence, the aim of this study was to develop a normative dataset of temporal sequence of loading, CPEI, and the transverse foot angle (TPFA) of healthy subjects with pes planus, rectus, and pes cavus foot types. We hypothesized that subjects with different foot types have significant different temporal sequence of loading, CPEI, and TPFA.

METHODS

Sixty-one healthy asymptomatic test subjects (22 pes planus, 27 rectus and 12 pes cavus) were recruited with no symptoms of pain, pathology, and visible pedal deformities. The foot type of each test subject was determined based on resting calcaneal stance position and forefoot-to-rearfoot alignment. Temporal sequence of loading (contact, midstance and propulsion phases of stance), CPEI, and TPFA were calculated from plantar pressure distributions. The emed X system (Novel gmbh, Germany) was employed to measure each individual's dynamic plantar pressure distribution. A custom software was developed in C++ to calculate each of these parameters. The effect of foot type was tested for each parameter, using a mixed effect analysis of variance (ANOVA) model. Significance was set at $p < 0.05$. A trend was operationally-defined at $p<0.1$. Post hoc t-tests were performed using the Bonferroni method ($P<0.0167$).

RESULTS

The temporal sequence of loading (contact, midstance, and propulsion) was not significantly different across foot type. Midstance on the left was nearly significant. CPEI demonstrated significant differences across pes planus and rectus as well as pes planus and cavus foot types. The transverse plane foot angle was significantly different across foot types on the right and was nearly significantly different on the left.

DISCUSSION

The temporal sequence of loading was not significantly different across foot types. CPEI and transverse plane foot angles did demonstrate differences between the rectus and planus and cavus and planus groups. No parameter in the study could distinguish the pes cavus from rectus foot types.

REFERENCES

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Table 1: Foot contact dynamic results

Parameters	Pes Planus-Right/Left	Rectus - Right/Left	Pes Cavus - Right/Left	ANOVA	P-Hocs
Contact (%St)	9.74(1.69) / 9.64(1.73)	9.81(1.54) / 9.71(1.55)	9.13(2.29) / 9.19(2.30)	0.14/ 0.33	
Midstance(%St)	49.93(5.64)/ 0.74(5.71)	48.91(5.13)/ 49.03(5.14)	50.25(7.67)/ 51.21(7,59)	0.43/ 0.10	
Propulsion(%St)	39.65(5.30)/39.58(5.62)	41.36(4.82)/ 41.16(5.03)	40.50(7.21)/ 39.58(7.47)	0.18/ 0.19	
CPEI (%)	18.73(5.84)/ 18.57(5.65)	22.08(5.16)/ 21.30(5.02)	24.45(7.76)/ 24.01(7.47)	<0.001-R,L	1,2/ 1,2
Foot Angle (°)	7.36(3.94)/7.22(4.86)	9.81(3.48)/8.64(4.32)	10.03(5.21)/9.35(6.43)	<0.001/0.08	1,2/ 1,2

%ST = %Stance, CPEI=Center of Pressure Excursion Index, Bonferonni post-hoc significance set at $p<0.0167$, 1 = Cavus vs Planus; 2 = Rectus vs. Planus; 3 = Cavus vs. Rectus